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MISSISSAGI RIVER
BANK STABILIZATION PROGRAM
AQUATIC MONITORING
1985

Report No 87-171-K

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ABSTRACT

Water quality and fish habitat were monitored below Red Rock GS on the Mississagi River in August of 1985 to determine the effect of river bank stabilization work on the aquatic environment. Water quality parameters deteriorated at the point of construction but returned to near ambient conditions 300 m downstream of construction. The spawning bed downstream of the construction activity was not adversely affected by sediment input. Mottled sculpin was the dominant fish species collected in 1985 day samples. This species was not collected in 1983. Yellow perch numbers were lower in the 1985 catches than the 1983 catches. No young of the year yellow perch were collected. The difference in 1983 and 1985 day fish numbers was not significant. Night fish abundance declined in 1985 although increases were recorded at three of the four construction sites. Rock bass and log perch were the predominant night species. Young of the year fish declined at night in 1985. The yearly variation between night fish abundance was not significant. Variation in fish abundance and species may be related to normal fish distribution, changes in year class strength or habitat changes.

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EXECUTIVE SUMMARY

MISSISSAGI RIVER BANK STABILIZATION PROGRAM
AQUATIC MONITORING, 1985

R.W. Sheehan
Biological Research Section
Chemical Research Department

Ontario Hydro commenced bank stabilization work along the Mississagi River between Red Rock GS and Mississagi Chutes in 1983. Water quality, fish habitat and fish population monitoring programs were conducted to determine the effect of the bank stabilization activities on the aquatic environment. These studies were repeated in 1985 during construction at undisturbed 1983 sites.

Measured water quality parameters deteriorated at the point of construction activity. Specific conductance and non-filtrable residue at 105°C values indicated an increase in the dissolved solids content. Turbidity and filtrable residue at 105°C values also indicated an input of suspended solids in the construction activity area. All water quality values had returned to ambient river levels 300 m downstream of the construction source due to river dilution.

Fish spawning bed substrate studies indicated that there was no significant difference between the substrate composition prior to construction in 1983 and during construction in 1985. This indicated that the spawning bed was not adversely affected by the deposition of suspended solids from upstream construction activities.

The numbers of fish collected in 1983 and 1985 day sampling periods were similar, however, species composition and distribution varied. Mottled sculpin and pink salmon were the dominant species collected in 1985 but neither species was collected in 1983. Yellow perch, the dominant 1983 species, declined in 1985 with a total absence of young of the year yellow perch. No significant differences between 1983 and 1985 fish catch numbers at control and construction sites with similar habitats were apparent.

Night fish abundance declined in 1985 although increases were recorded at 3 of the 4 construction sites. Rock bass and log perch were the dominant

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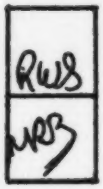
1985 fish species while yellow perch was dominant in 1983. Young of the year fish abundance decreased from 1983 to 1985. The yearly variation between night fish abundance at control and construction sites with similar habitats was not significant.

The yearly changes in fish abundance and species composition at sites may be related to normal fish distribution, changes in year class strength or habitat changes.



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To Dr. W. R. Effer
Manager
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Design and Development Division

MISSISSAGI RIVER
BANK STABILIZATION PROGRAM
AQUATIC MONIORING 1985

1.0 INTRODUCTION

Ontario Hydro commenced river bank stabilization work along the Mississagi River between Red Rock GS and Mississagi Chutes in 1983. Bank stabilization would permit Ontario Hydro to continue its peaking operations without damaging private land and reduces bank erosion attributable to natural phenomena (land runoff and flood flows). The Environmental Studies and Assessments (ES&A) Department of Design & Development Division requested monitoring studies to assess the effect of the bank stabilization on the aquatic environment of the Mississagi River. Water quality, fish habitat and fish population monitoring programs were conducted by ES&A and Research personnel in 1983 during different construction activities (bank clearing, rock placement and final bank shaping, OHRD Report 84-144-K). ES&A personnel performed water quality and habitat monitoring studies in 1984. In 1985 studies were conducted by ES&A and Research personnel as a continuation of the 1983 program. Construction activities were in progress primarily at sites that were undisturbed in 1983.

2.0 METHODS

2.1 Water Quality

Water samples were collected on August 22, during the construction, to provide information on the extent of the construction effects on water quality. Water samples were collected in a downstream sequence at 5 locations 50 m apart, commencing at a construction activity (bank trimming turbid water plume source, Figure 2.0-1*). The water samples were collected by immersing 1-litre borasilicate glass bottles 1 m off the river bed in the visible construction plume. Secchi disc measurements were taken at each of the collection points. All samples were refrigerated and

* attached to back cover

submitted to Analytical Services, Chemical Research Department, for analyses of conductivity, non-filtrable residue at 105°C and 550°C, filtrable residue at 105°C and 550°C, and turbidity.

2.2 Spawning Habitat

The gravel bar 50 m downstream from the west side of the Highway 17 bridge centre span in the town of Iron Bridge was sampled on August 20 for particle size distribution (Figure 2.0-1). Triplicate samples were collected with a 12 cm pipe sampler. Comparison of manually inserted ponar dredge and pipe samples during the 1983 study (OHRD 84-144-K) indicated that the pipe sampler was the better sampling device. The loss of fine particles was minimized by enclosing the pipe sampler in a plastic bag as it was removed from the substrate. Each sample was sieved through a series of 8 sieves (31.5-0.038 mm) using the wet sieving method. The samples were oven dried to a constant weight and the results expressed as per cent by weight in each particle size range. One way analysis of variance was applied to early construction and construction results to determine whether the particle size distribution of the spawning bed was significantly altered during construction activities (OHRD Report 84-144-K).

2.3 Fish Monitoring

An assessment of the effect of the riprap on fish productivity and habitat was conducted at 10 selected shoreline sites with the use of electroshocking equipment (OHRD Report 84-144-K). All sites were electrofished for approximately 100 m stretches. Each site was marked with reflective tape to provide reference points for night electrofishing studies. All sampling was conducted in a downstream sequence commencing at site A (Red Rock GS tailrace). Control sites C, D, I and J were slightly altered within similar habitat to avoid areas of new rock placement. Lights powered by a portable generator were installed on the shocking boat to illuminate the work area during night studies. Fish populations were sampled during 2 night (August 20-21 and 21-22) and 1 day periods. All fish collected were identified, counted and released.

3.0 RESULTS

3.1 Water Quality

The water quality analysis results are presented in Appendix A. No water quality sample was collected above the active construction area to provide ambient water quality data. The 1985 results are therefore presented with August 1983 and 1984 water quality analyses from Red Rock tailrace as comparison of previous ambient water quality conditions.

3.1-1 Specific Conductance

Specific conductance is a measure of the total amount of ionized material in the water. The highest specific conductance value (7.4 mS/m) was

recorded at the upstream construction activity sampling location (Figure 2.0-1). Lower specific conductance values were recorded at all downstream sampling sites. These values were similar to the mean specific conductance value determined for Red Rock tailrace in 1983 and 1984 (6.3 mS/m).

3.1-2 Non-filtrable Residue at 105°C

Non-filtrable residue at 105°C (total dissolved solids) is a measure of the material that remains after the water is removed from a filtered portion of a sample by evaporation. The values of this parameter declined in downstream progression from the plume source (36 mg/L) to 300 m downstream (15 mg/L, Figure 3.1-1). All of the values were similar or less than the August 1984 value recorded at the Red Rock tailrace (35 mg/L). The non-filtrable residue levels did not exceed Ontario Ministry of Environment (OMOE) provincial water quality objectives (OMOE 1984).

3.1-3 Non-filtrable Residue at 550°C

Non-filtrable residue at 550°C is a measure of the quantity of material (inorganic and non-volatile) that remains as a residue when the non-filtrable residue at 105°C is ignited at 550°C for 1 hour. The values of this parameter decreased with distance from the construction activity. Values ranged from 24 mg/ L at the point of construction to 10 mg/L 300 m downstream (Figure 3.1-1). The downstream values are similar to those recorded in August 1983 and 1984 at a site upstream from the construction activity (Appendix A).

3.1-4 Turbidity

Turbidity is a measure of the optical properties of a sample which causes light to be scattered rather than transmitted in a straight line. The highest turbidity value (15.0 NTU) was recorded at the source of the construction plume. Turbidity decreased in a downstream sequence to 0.6 NTU 300 m below the active construction area (Figure 3.1-2). A similar mean turbidity value of 0.6 NTU was determined for the Red Rock tailrace in 1983 and 1984. The reduction in turbidity with downstream distance is a result of the dilution effect of the river system.

3.1-5 Filtrable Residue at 105°C

Filtrable residue at 105°C (suspended solids) is an indicator of the quantity of material that is removed from a water sample by filtration (1 μm filter). Filtrable residue at 105°C decreased from 10 mg/L to 2 mg/L 50 m below the construction plume source. Values at the sampling sites further downstream were all below the limits of detection (<2 mg/L). The highest level recorded in 1983 was 5.5 mg/L.

Figure 3.1-1

Non-filtrable Residue at 105 and 550 C
Values (mg/L), Mississagi River, 1985

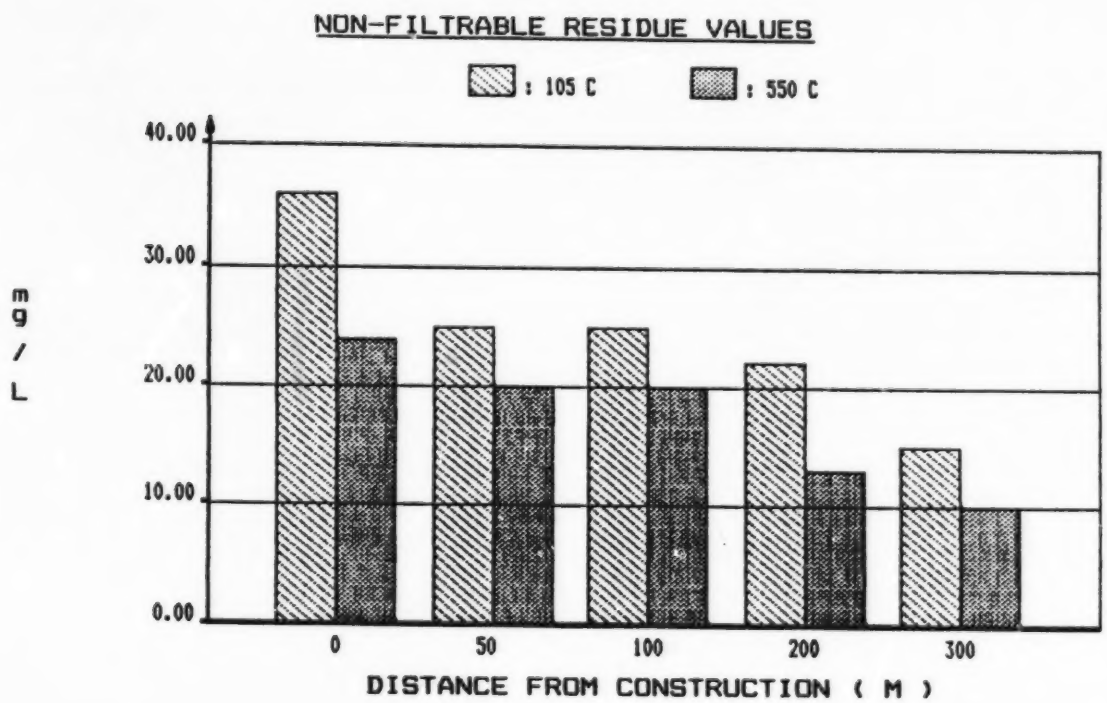
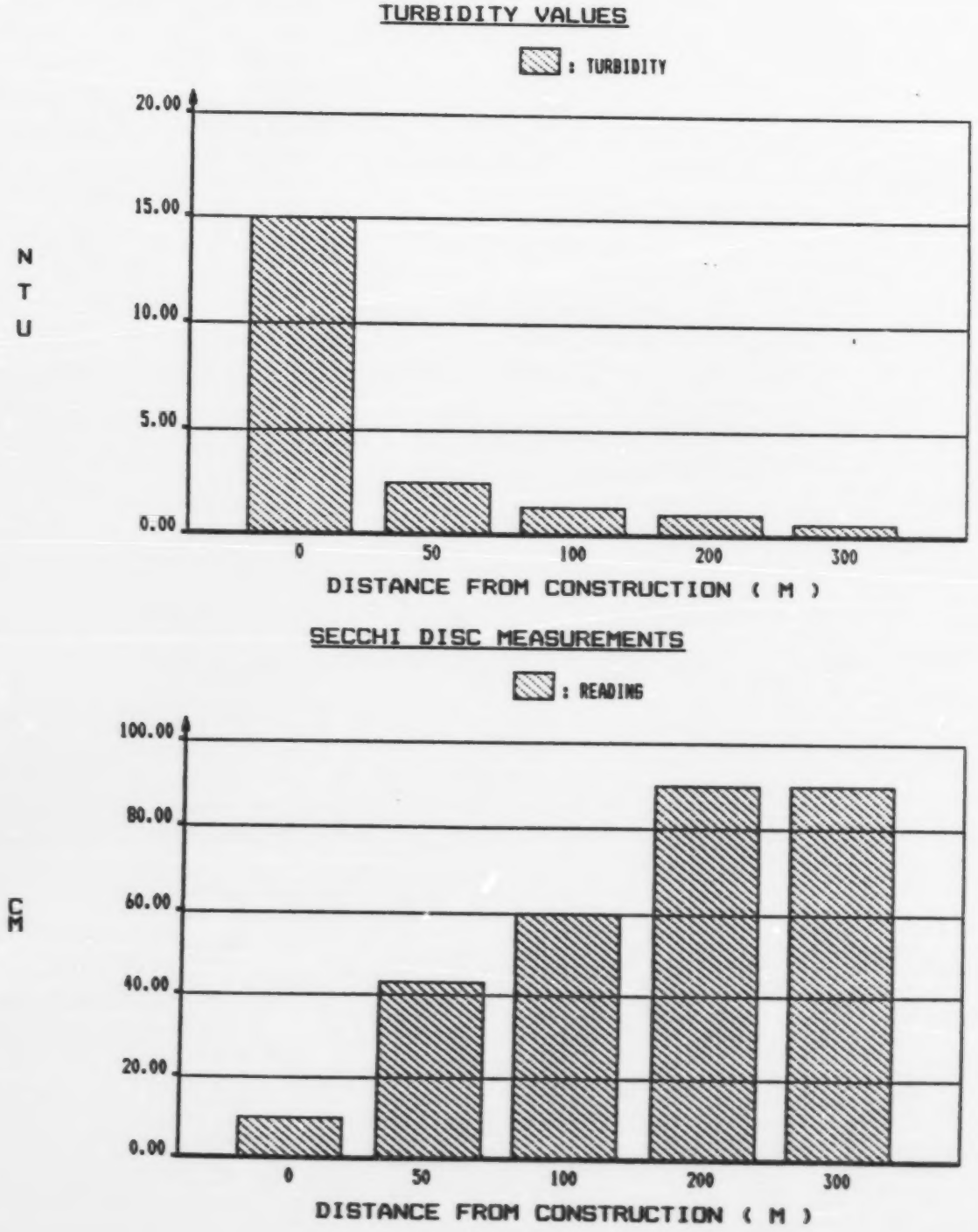


Figure 3.1-2

Turbidity Values (NTU) and Secchi Disc Readings (m), Mississagi River, 1985



3.1-6 Filtrable Residue at 550°C

Filtrable residue at 550°C is a measure of the quantity of material (inorganic and non-volatile) that remains as a residue when the filtrable residue at 105°C is ignited at 550°C for 1 hour. The values were similar to the filtrable residue at 105°C values decreasing from 10 mg/L at the construction source to 2 mg/L 50 m downstream. Similarly, all values further downstream were less than the detection limit (2 mg/L).

3.1-7 Secchi Disc Measurements

A Secchi disc measurement of 0.1 m was recorded at the start of the visible construction plume (Figure 3.1-2). Measurements at 50 and 100 m below the construction activity increased to 0.4 and 0.6 m respectively. Secchi disc readings of 0.9 m were recorded 200 and 300 m downstream from active construction. These values probably reflect ambient river conditions. The OMOE water quality objectives state that Secchi disc values should not change by more than 10% when materials are added to surface water. Secchi disc values in the immediate vicinity of the construction plume exceeded the guidelines. However the dilution effect of the river system resulted in ambient Secchi disc values 200 m downstream of construction.

3.2 Spawning Habitat

The 1985 particle size distribution of spawning beds are presented in Appendix B. Analysis of the samples indicated the pebble-gravel component (2.0 - 31.5 mm) was predominant making up 60.5% of the substrate. Pebble alone (>31.5 mm, and coarse sand (0.5 - 2.0 mm), were the other major components contributing to 21.4 and 15.7% of the substrate, respectively. Medium sand (0.250 - 0.5 mm) and fine sand (0.125 - 0.250 mm) mean values were 2.2 and 0.1%, respectively. Particle sizes less than 0.125 mm comprised less than 0.1% of the substrate.

3.3 Fish Monitoring

3.3-1 Daylight

A total of 125 fish comprising 10 fish species were collected during the daylight electrofishing period (Appendix C). Mottled sculpin, pink salmon, log perch and yellow perch were the four dominant species sampled. The majority of fish (number [n] = 61) were collected at construction sampling site E where mottled sculpin was the dominant fish species (n = 51). Pink salmon was the predominant fish species collected at control site A (n = 20). No fish were collected at control site B and construction site H. Species diversity was highest at control site A (n = 5).

3.3-2 Night

A total of 509 fish comprising fifteen species were collected during the two night sampling periods (Appendix C). Rock bass and log perch were the dominant species and were present at all sampling sites. Yellow perch and mottled sculpin were also common but were not present at all sampling locations. Species diversity was also highest at control site A (n = 10) during the night sampling.

Fish abundance was highest at construction site G ($\bar{x}$ = 44.0 fish/100 m) of shoreline, Table 3.3-1). Mottled sculpin (19.5 fish/100 m), rock bass (12.0 fish/100 m) and log perch (10.5 fish/100 m) were the dominant species at site G. Mean fish abundance was similar at control site J and construction sites E and H where mean fish catches were 40.5, 39.5 and 38.5 fish/100 m of shoreline, respectively. The lowest fish abundance was recorded at control site D (4.5 fish/100 m). Salmonids (Pink Salmon) were only taken at control sites A and C. The densities of pink salmon at these sites were 7.0 and 0.5/100 m respectively.

The mean fish abundance was greater at the treated quarried stone sites (E, F, G and H) than at the cobble - boulder control sites (A and B, Table 3.3-2). Adults were the dominant age class at both the construction and control sites. Rock bass and log perch, were more numerous at the construction sites than at the control sites.

The sand, debris and aquatic vegetation type shoreline habitat was limited to control sites C, D, I and J. Fish abundance at the downstream control sites (I and J) was greater than at the upstream sites (C and D, Table 3.3-2). Yellow perch was the most abundant species collected at the controls, and was taken mainly at site J. Adults comprised the greatest number of fish at both upstream and downstream control sites.

4.0 DISCUSSION

4.1 Water Quality

4.1-1 Specific Conductance

Yearly variation in specific conductance values was minimal. Specific conductance values increased slightly at the points of construction activity indicating an increase in dissolved solids. The specific conductance decreased downstream of construction where levels were similar to 1983 and 1984 levels. The return of specific conductance to ambient levels downstream from the construction area was probably a result of river dilution. The low specific conductance values are typical for the Mississagi River (McNeely 1979).

TABLE 3.3-1

FISH ABUNDANCE
(Number of Fish/100 m of Shoreline)
NIGHT SAMPLING SITES
MISSISSAGI RIVER, 1983 - 1985

SITE	TOTAL NUMBER		NUMBER WITHOUT SALMONIDS		ADULTS		YOUNG OF YEAR		SITE DESCRIPTION
	1983	1985	1983	1985	1983	1985	1983	1985	
A	49.3	20.5	12.3	13.5	5.7	13.0	6.6	0.5	RED ROCK TAILRACE, COBBLE
B	12.0	16.5	12.0	16.5	11.0	16.5	1.0	0.0	SHINO RAPIDS, COBBLE
C	32.0	7.5	32.0	7.0	9.0	6.5	23.0	0.5	CONTROL, SAND AND DEBRIS
D	9.0	4.5	9.0	4.5	6.0	4.5	3.0	0.0	CONTROL, SAND AND DEBRIS
E	38.0	39.5	38.0	39.5	5.0	39.5	33.0	0.0	QUARRIED STONE, EAST BANK
F	118.0	30.0	118.0	30.0	11.0	30.0	107.0	0.0	QUARRIED STONE, WEST BANK
G	9.0	44.0	9.0	44.0	5.0	44.0	4.0	0.0	QUARRIED STONE, EAST BANK*
H	10.0	38.5	10.0	38.5	2.0	37.5	8.0	1.0	QUARRIED STONE, EAST BANK**
I	23.0	13.0	23.0	13.0	22.0	12.5	1.0	0.5	CONTROL, SAND AND DEBRIS
J	24.0	40.5	24.0	40.5	4.0	40.5	20.0	0.0	CONTROL, SAND AND VEGETATION

* - Debris Cleared, Sand (1983)

** - Debris Cleared, Sand and Vegetation (1983)

(C3)

TABLE 3.3-2

FISH ABUNDANCE AT SHORELINE TYPES
(Number of Fish/100 m of Shoreline)
MISSISSAGI RIVER, 1985

QUARRIED STONE AND COBBLE - BOULDER

	CONTROL (SITES A,B)	TREATED (SITES E,F,G,H)
MEAN NUMBER	18.5	38.0
WITHOUT SALMONIDS	15.0	38.0
ADULTS	14.8	37.8
YOUNG OF YEAR	0.2	0.2
ROCK BASS	2.0	14.3
LOG PERCH	5.5	12.9

SAND AND AQUATIC VEGETATION

	CONTROL (SITES C,D,I,J)		
	UPSTREAM C & D	DOWNSTREAM I & J	COMBINED
MEAN NUMBER	6.0	26.8	16.4
WITHOUT SALMONIDS	5.8	26.8	16.3
ADULTS	5.5	26.5	16.0
YOUNG OF YEAR	0.3	0.3	0.3
YELLOW PERCH	0.5	15.8	8.1

4.1-2 Non-filtrable Residue at 105°C

The 1985 non-filtrable residue at 105°C indicated an increase in dissolved solids at the point of construction activity. Values generally decreased with distance below the point of construction as a result of river dilution. All 1985 non-filtrable residue at 105°C values were less than the mean ambient August 1983 and 1984 Red Rock tailrace value (51 mg/L) and were within OMOE water quality guidelines (1984).

4.1-3 Non-filtrable Residue at 550°C

Non-filtrable residue at 550°C declined in downstream progression from the area of construction activity to a value similar to the mean August 1983 and 1984 value (10 mg/L). This indicated a return to near normal non-filtrable residue at 550°C levels downstream of the construction. The highest 1985 non-filtrable residue at 550°C value (24 mg/L) was less than the value recorded at the plume source during 1983 construction (30 mg/L) and less than October 1983 Red Rock tailrace values (54 and 52 mg/L).

4.1-4 Turbidity

Turbidity values in the vicinity of the 1985 construction activity increased above ambient conditions. The increase was localized with turbidity values returning to the mean August 1983 and 1985 level 300 m downstream of the construction. The maximum 1985 turbidity value was half as high as the value recorded in August 1983.

4.1-5 Filtrable Residue at 105°C

The highest filtrable residue at 105°C value (10 mg/L) in 1985 was recorded at the turbid plume source. The highest previously recorded value was 4 mg/L at the construction plume source in August 1983. However the river system rapidly diluted the filtrable residue to values below the detection limits at all sites greater than 100 m downstream of the construction plume source. Mathers (1978) noted that the maximum deposition of suspended solids occurred within the first 200 m below the construction source on a small stream while increased suspended solid levels were detectable as far as 600 m downstream.

4.1-6 Filtrable Residue at 550°C

The 1985 filtrable residue at 550°C value (10 mg/L) was the highest value recorded during the monitoring studies. However, values recorded 100 m or more downstream of the construction activity were below detection limits. The mean August 1983 and 1984 values recorded at Red Rock tailrace were also below the detection limits. No detectable difference was evident between the 1985 filtrable residue at 105°C and 550°C values. This indicates that the suspended solids were primarily inorganic non-volatile materials.

4.1-7 Secchi Disc Measurements

Secchi disc values in 1983 indicated reduced transparency in areas of construction activity compared to background readings. The 1983 Secchi disc readings were equivalent to readings 0.5 km downstream of the turbid plume source (OHRD Report 84-144-K). In 1985 no background readings were made. Secchi disc values increased from 0.1 m at the plume source to 0.9 m 300 m downstream of the construction activity in 1985. The 1985 Secchi disc readings are lower than those recorded in 1983 (0.3 - 3.0 m). This suggests that ambient readings were lower in 1985. As in 1983 the dilution effect of the river system and deposition of the sediment load probably resulted in lower Secchi disc readings downstream of construction.

4.2 Spawning Habitat

The spawning bed south of the highway 17 bridge in Iron Bridge did not appear to be adversely affected by the upstream construction activity. Variation between early construction (July 1983) and mid construction (August 1983, 1984 and 1985) particle size values (Figure 4.2-1) was not significant ($P>0.05$, Table 4.2-1). The per cent composition for the medium and fine sand components decreased slightly in 1984 and 1985 below 1983 values. This variation was significant when individual sampling period results were compared. The variation in the per cent composition of the individual coarse sand components (0.5 - 1.0 mm and 1.0 - 2.0 mm) between sampling periods was also significant. However when analyzed collectively as coarse sand the variation was not significant ($P>0.05$, dF 3,83, F value 0.010085).

Sediment materials greater than 1 - 2 mm in size are not readily transportable (Hansen, 1971). Hansen (1976) indicated that silts and clays were quickly washed through a 1.6 km section of a low gradient trout stream whereas sand was deposited in the stream bed. Burns (1970) found initial increases in fine sediments (<0.8 mm) on salmon spawning beds during northern California logging operations. However, this material was washed away during winter rains. Similarly, Shapely and Bishop (1965) indicated moderate freshets will remove fine sediments from gravel riffles. The Red Rock GS was run as a peaking operation with higher water flows during the night and lower flows during the day when construction activity was occurring. Any fines that were deposited on the spawning bed during upstream daylight construction operations would probably have been resuspended and moved further downstream during periods of night peaking water flows or natural runoff.

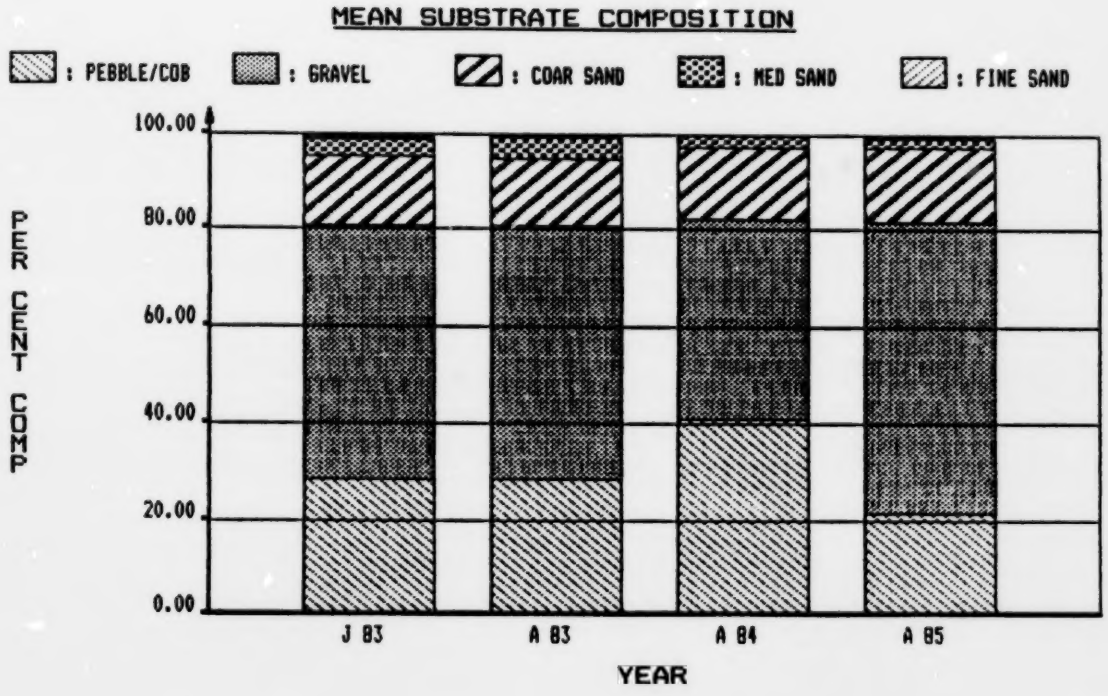
4.3 Fish Monitoring

4.3-1 Daylight

The numbers of fish collected in 1983 (n = 120) and 1985 (n = 125) daylight sampling periods were similar. Ten species of fish were also collected in each of 1983 and 1985 comprising a total of 15 species overall. Species

Figure 4.2-1

Mean Substrate Composition
Mississagi River, 1983 - 1985



PEBBLE/COBBLE - > 31.5 mm

GRAVEL - 2.0 - 31.5 mm

COARSE SAND - 0.5 - 2.0 mm

MEDIUM SAND - 0.25 - 0.50 mm

FINE SAND - < 0.25 mm

J - JULY

A - AUGUST

TABLE 4.2-1

ANOVA

SPAWNING BED

MEAN PARTICLE SIZE

MISSISSAGI RIVER, 1983 - 1985

	YEARLY VARIATION			EARLY CONSTRUCTION VS. CONSTRUCTION VARIATION		
	1983 - 1985			JULY 1983 VS. AUGUST 1983 - 1985		
PARTICLE SIZE (MM)	SIGNIFICANCE	DF	F VALUE	SIGNIFICANCE	DF	F VALUE
>3.15	NS	3,8	2.16459	NS	1,10	0.03012
2.00 - 3.15	NS	3,8	2.07062	NS	1,10	0.01816
1.00 - 2.00	S	3,8	4.32124	NS	1,10	2.32491
0.500 - 1.00	S	3,8	6.86292	NS	1,10	3.65207
0.250 - 0.500	S	3,8	10.9714	NS	1,10	0.63483
0.125 - 0.250	S	3,8	5.44445	NS	1,10	0.39557
0.063 - 0.125	NS	3,8	1.33333	NS	1,10	-3.33333
0.038 - 0.063	NS	3,8	1.33333	NS	1,10	-3.33333
<0.038	NS	3,8	1.33333	NS	1,10	-3.33333

NS - not significant (P>0.05)

S - significant (P<0.05)

(C3)

common to both sampling years were redhorse sucker, rock bass, yellow perch, walleye and log perch. Mottled sculpin and pink salmon were the dominant species in 1985 (Table 4.3-1). However neither species was collected during day sampling in 1983. Cyprinidae (bluntnose minnow, emerald shiner and spottail shiner) were not present in 1985 catches but ranked second in the 1983 fish catch. Yellow perch was the dominant species collected (n = 62) in 1983 primarily at construction site H (n = 52, OHRD Report 84-144-K).

In 1985 only 15 yellow perch were collected, none at site H. The majority of yellow perch collected in 1983 were young of the year fish (n = 50) all collected at site H. No young of the year fish were collected in 1985.

The absence of yellow perch at construction site H in 1985 may be related to the change in habitat. Site H was composed primarily of a sand substrate in 1983 (OHRD Report 84-144-K). In 1985 the substrate was primarily quarried stone. The change may also be related to normal movement patterns of yellow perch which are normally found in loose aggregations (MacKay, 1969) or to a change in year class strength. It is not known whether the increase in mottled sculpin numbers at construction site E is due to a preference for the altered shoreline. This species is usually associated with sand substrates (Scott and Crossman 1973).

Fish numbers increased substantially at construction site E in 1985, with a smaller increase recorded at control site A (Figure 4.3-1). Substantial decreases in fish numbers occurred at construction site H and control site I in 1985. Analysis of the variation in numbers of fish collected at control and construction locations with similar habitats indicated no significant differences ($P > 0.05$) between 1983 and 1985 fish catch numbers (Table 4.3-2).

4.3-2 Night

Fifteen species were collected in each of the sampling years during the night sampling periods comprising a total of 19 species overall. Rock Bass and log perch were the most common species in 1985 and yellow perch was the most common species in 1983 (Table 4.3-1). Fish abundance declined from 32.4 fish/100 m of shoreline in 1983 to 25.5 fish/100 m of shoreline in 1985.

Fish numbers (without Salmonids) increased slightly at boulder/cobble control sites A and B between 1983 (12.2 fish/100 m) and 1985 (15.0 fish/100 m Figure 4.3-2). Between 1983 and 1985, fish abundance increased at construction sites E, G and H, and decreased substantially at site F. Site F was sampled while active construction work was in progress in 1983. Analysis of the fish catch numbers collected at the control sites A and B and the construction sites E, F, G and H in 1983 and 1985 indicated no significant year to year variation ($P > 0.05$, Table 4.3-2). There were also no significant year to year differences between the numbers of fish collected at control sites A and B in 1983 and 1985 or at construction

TABLE 4.3-1

DOMINANT FISH SPECIES
MISSISSAGI RIVER, 1983 - 1985

DAYLIGHT

1985

SPECIES	MEAN NUMBER OF FISH PER 100 M OF SHORELINE
Mottled sculpin	54
Pink salmon	20
Log perch	19
Yellow perch	15

1983

Yellow perch	62
Cyprinidae*	35
Log perch	9

NIGHT

1985

SPECIES	MEAN NUMBER OF FISH PER 100 M OF SHORELINE
Rock bass	74.0
Log perch	70.5
Yellow perch	35.5
Mottled sculpin	35.0
Smallmouth bass	11.0

1983

Yellow perch	21.2
Pink salmon	3.6
Cyprinidae*	2.8
Log perch	1.7
Walleye	1.3

* Cyprinidae - Bluntnose minnow, mimic shiner, emerald shiner

Figure 4.3-1

Daylight Fish Abundance
(excluding Salmonids)
Mississagi River, 1983-1985

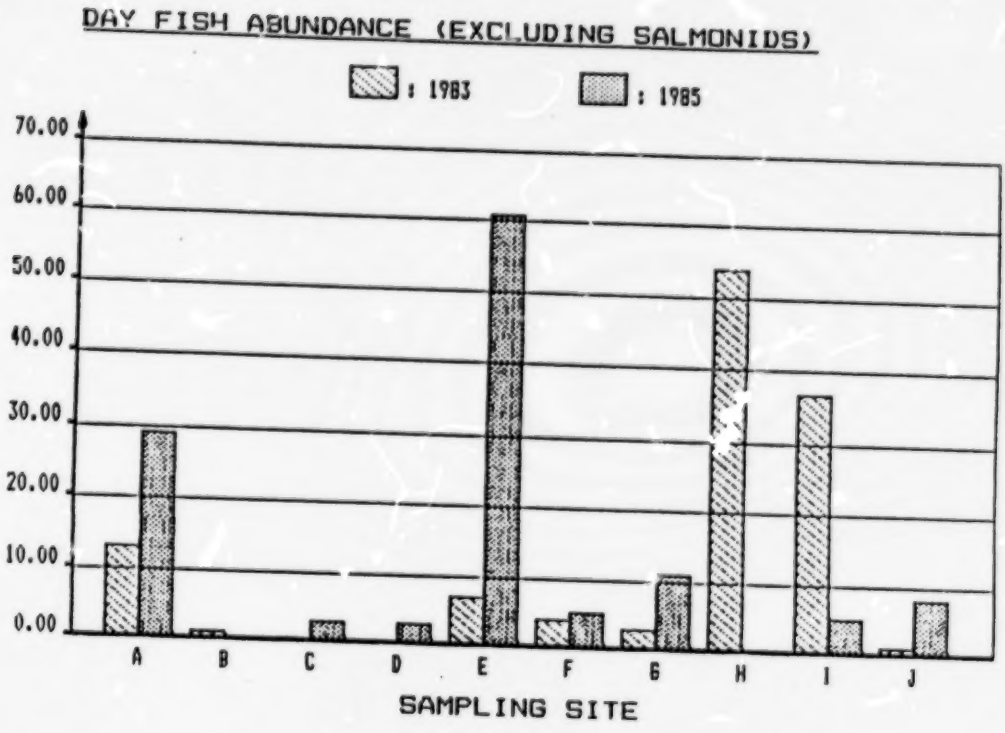


Figure 4.3-2

Night Fish Abundance
(excluding Salmonids)
Mississagi River, 1983-1985

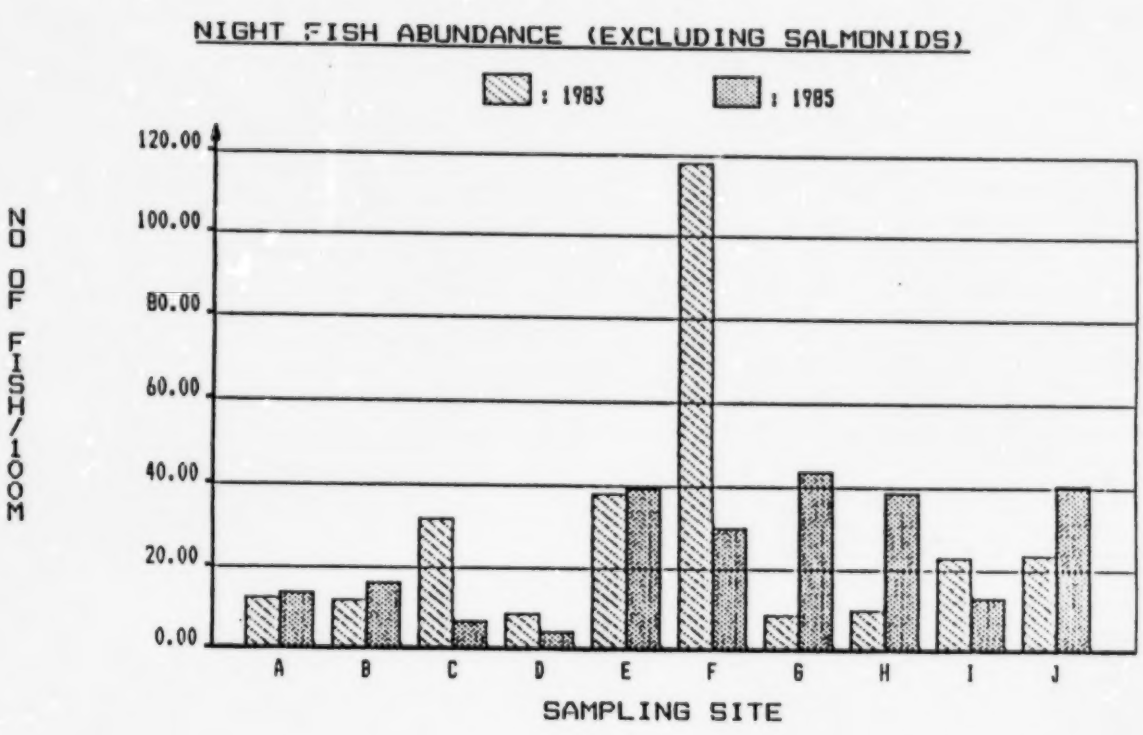


Table 4.3-2

FISH CATCH ANOVA TABLES
MISSISSAGI RIVER
1983 AND 1985

DAYLIGHT FISH CATCH

SITES COMPARED	SIGNIFICANCE (P>0.05)	DF	F VALUE
AB 1983 AND 1985/ EFGH 1983 AND 1985	NS	1,10	0.303583
AB 1983/ AB 1985	NS	1,2	0.228427
CDIJ 1983/ CDIJ 1985	NS	1,6	0.263954
EFGH 1983/ EFGH 1985	NS	1,6	0.0144007

NIGHT FISH CATCH

AB 1983 AND 1985/ EFGH 1983 AND 1985	NS	1,18	0.645458
AB 1983/ AB 1985	NS	1,6	0.915068
CDIJ 1983/ CDIJ 1985	NS	1,10	0.29838
EFGH 1983/ EFGH 1985	NS	1,10	0.0982137

sites E, F, G and H in 1983 and 1985.

Fish abundance at sand control sites generally decreased slightly with an increase in numbers only occurring at site J where the number of adults increased (Figure 4.3-3). However fish catch numbers were not significantly different ($P > 0.05$) at combined upstream and downstream sand control locations from 1983 to 1985 (Table 4.3-2).

The number of adult fish collected in 1985 was greater at the boulder/cobble control sites (A and B) and all construction sites than in 1983 (Figure 4.3-3). However young of the year fish numbers declined at all of these sites in 1985. No young of the year fish were collected at control site B or construction sites E, F or G in 1985. Young of the year fish numbers also decreased at the sand control sites. The decrease in young of the year fish may be related to fish distribution at the time of sampling rather than to a construction effect since young of the year yellow perch also declined at the control sites. The decrease may also be related to a change in year class strength.

Rock bass were collected at all sampling locations in 1985. They were present at only 3 sites (A, G and J) in 1983. Total abundance increased from 0.5 fish/100 m of shoreline (1983) to 7.4 fish/100 m of shoreline (1985). The greatest rock bass catches occurred at the construction sites. Rock bass are generally found in schools in rocky areas of streams but can also be found in sandy areas (Scott and Crossman, 1973). The increase in rock bass numbers may also partially account for the decrease in yellow perch numbers since rock bass prey on yellow perch (Scott and Crossman 1973).

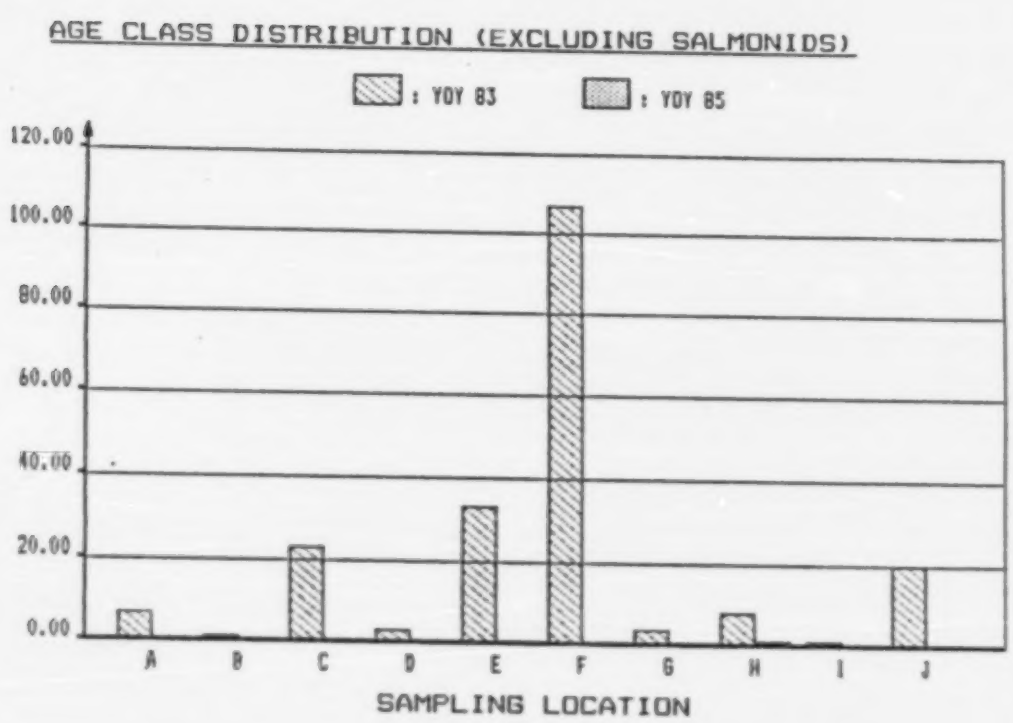
The numbers of logperch and mottled sculpins also increased in 1985 (Table 4.3-1). Logperch inhabit a variety of habitats with substrate composed of sand, gravel or rock (Scott and Crossman 1973). They were located at all sampling sites in 1985 with greatest numbers taken at the construction sites. Mottled sculpins usually inhabit areas of sandy substrate with low current velocities (Scott and Crossman 1973). However, they were primarily located at construction site E with a substrate composed of cobble (200 mm minus quarry stone Appendix D).

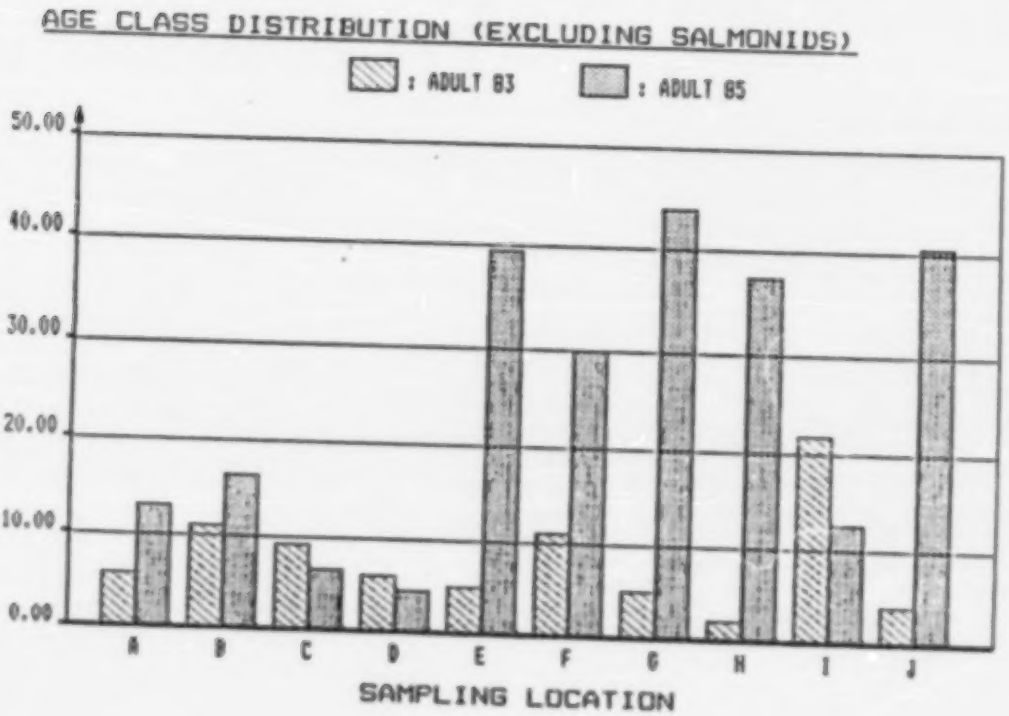
5.0 RECOMMENDATIONS

1. Future surveys should be conducted to monitor the changes in fish distribution at the construction and control sites. These surveys should be conducted for 2 weeks in August in order to account for seasonal changes in fish distribution.

Figure 4.3-3

Night Fish Catch Age Distribution
(excluding Salmonids)
Mississagi River, 1983-1985





6.0 ACKNOWLEDGEMENTS

I wish to thank D. Lowther for his assistance in collecting the field data and preliminary data preperation. D. Chubbuck and J. Maher (ES&A) assisted with the field collection and reviewed the manuscript.

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APPENDIX A

WATER QUALITY ANALYSIS RESULTS

MISSISSAGI RIVER, 1985

WATER SAMPLE LOCATION

	Site 1	Site 2	Site 3	Site 4	Site 5	Red Rock Tailrace 1983	Red Rock Tailrace 1984	Red Rock Tailrace x
TURBIDITY NTU	15.0	2.5	1.4	1.0	0.6	0.4	0.8	0.6
CONDUCTIVITY mS/m	7.4	6.4	6.2	6.1	6.2	5.9	6.6	6.3
FILTRABLE RESIDUE mg/L								
@ 105°C	10	2	<2	<2	<2	<1	2	<2
@ 550 °C	10	2	<2	<2	<2	<1	<2	<2
NON-FILTRABLE RESIDUE mg/L								
@ 105°C	36	25	25	22	15	66	35	51
@ 550°C	24	20	20	13	10	14	6	10

(C3)

APPENDIX B

SPAWNING BED
PARTICLE SIZE ANALYSIS
MISSISSAGI RIVER, 1983 - 1985

SIEVE OPENING (mm)	REPLICATE	JULY 1983				AUGUST 1983				1984				1985			
		1	2	3	$\bar{x}$	1	2	3	$\bar{x}$	1	2	3	$\bar{x}$	1	2	3	$\bar{x}$
		Per Cent of Substrate (Dry Weight)															
31.5		40.0	37.0	9.7	28.9	26.8	31.0	27.3	28.4	37.0	37.6	48.0	40.9	16.0	28.1	20.3	21.4
2.00		38.1	47.6	71.2	52.3	57.9	46.2	52.6	52.2	47.5	37.6	38.0	41.0	65.0	58.9	57.7	60.5
1.00		4.9	1.8	4.1	3.6	2.4	3.2	4.7	3.4	7.7	13.1	6.6	9.1	9.5	6.8	16.4	10.9
0.500		13.1	8.6	11.2	11.0	8.5	13.0	10.2	10.6	5.7	8.1	4.9	6.2	7.0	3.9	3.5	4.8
0.250		3.5	4.6	3.5	3.9	4.1	6.0	4.6	4.9	1.9	3.1	2.3	2.4	2.4	2.1	2.0	2.2
0.125		0.3	0.3	0.2	0.3	0.3	0.5	0.3	0.4	0.1	0.3	0.1	0.2	<0.1	<0.1	0.1	0.1
0.063		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
0.038		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.038		-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

APPENDIX C

ELECTROFISHING FISH CATCH DATA

MISSISSAGI RIVER, 1985

NIGHT SAMPLING

STATION	A		B		C		D		E		F		G		H		I		J		
DATE	20	21	20	21	20	21	20	21	20	21	20	21	20	21	20	21	20	21	20	21	TOTAL
LAMPREY		1																			1
PINK SALMON	12	2			1																15
WHITE SUCKER					1												1	1			3
REDHORSE SUCKER	1				1	1								1							4
EMERALD SHINER	3		5			1		1		1								3			14
SPOTTAIL SHINER																				2	2
BLUNTNOSE MINNOW									1										2		3
BURBOT		1											1								2
ROCK BASS		1	4	3	2		3			14	15	11	11	13	30	20	5	4	4	8	148
PUMPKINSEED																			2		2
SMALLMOUTH BASS																					22
ADULT	1	1	5						1	2	2		1	1	2	1	4				21
YOUNG OF YEAR															1						1
YELLOW PERCH																					71
ADULT		1			1		1		1	1					1	1	1	5	49	8	70
YOUNG OF YEAR															1						1
WALLEYE																					11
ADULT	3	4						1													8
YOUNG OF YEAR		1			1												1				3
LOG PERCH	6	3	7	6	1	5	1	2	33	13	6	11	9	12	14	5		1	5	1	141
MOTTLED SCULPIN			3						2	10	3	12	5	34	1						70
TOTAL	26	15	24	9	8	7	5	4	38	41	26	34	27	61	50	27	12	14	62	19	509

DAY SAMPLING

STATION	A	B	C	D	E	F	G	H	I	J	
DATE	21	21	21	21	21	21	21	21	21	21	TOTAL
PINK SALMON	20										20
WHITE SUCKER			3						1		4
REDHORSE SUCKER	1										1
COMMON SHINER							1				1
ROCK BASS						1					1
SMALLMOUTH BASS	1						1		1	2	5
YELLOW PERCH	2			3	1				3	6	15
WALLEYE											5
ADULT	3										3
YOUNG OF YEAR	2										2
LONG PERCH					9	4	6				19
MOTTLED SCULPIN					51		3				54
TOTAL	29	0	3	3	61	5	11	0	5	8	125

APPENDIX D

SAMPLING LOCATION SUBSTRATE

MISSISSAGI RIVER, 1985

SITE		SUBSTRATE	CURRENT	AQUATIC VEGETATION
RED ROCK	A	BEDROCK - 70% COBBLE - 30%		NONE
SHINO RAPIDS	B	BOULDER - 60% COBBLE - 40%		NONE
	C	SAND - 100%		30% WEED COVERAGE - Sparganium sp - Potomogeton epihydrus SAND INTERSPERSED WITH STUMPS AND LOGS
	D	BOULDER - 4%	35 - 50 CM/SEC	50% WEED COVERAGE - Potomogeton epihydrus - Sparganium sp - Potomogeton gramineus - Potomogeton obtusifolius
		COBBLE - 4% PEBBLE - 2% SAND - 90%		SAND INTERSPERSED WITH NUMEROUS TREES
	E	COBBLE - 100%		NONE
	F	COBBLE - 100%	30 CM/SEC	NONE
	G	COBBLE - 100%		NONE
	H	COBBLE - 100%		NONE
	I	SAND - 100%		80% WEED COVERAGE - Sparganium sp - Vallisineria americana OCCASIONAL SUBMERGED LOG
	J	SAND - 100%	5 CM/SEC	100% WEED COVERAGE 50% STUMPS

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